

Present status and conservation strategies of mangrove resource in Guangdong, P. R. China

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Abstract: According to the survey of Guangdong mangrove resource in 2001 and author's field investigations in the past 5 years, the total mature mangrove land area of Guangdong Province was estimated at 9084 hm², accounting for 41.4% of total mangrove land area of China. These mangrove forests totally consisted of 50 species belonging to 28 families, distributed at more than 100 locations along the coastlines of Guangdong and most of them present a high dense and dwarf appearance. The *Ass. Avicennia marina* is the most dominant mangrove association. The investigation results showed that the mangrove forests with coverage rates above 0.7 accounted for 68.0% of the total mangrove land area of the province and 77.8% of mangrove forests was less than 2 m in tree height. Since 1950, 54.6% of mangrove forests have disappeared due to paddy rice reclaim, aquaculture and city constructions. Derivational conservation efforts are still weakly empowered and should be strengthened intensively. The author suggested that mangrove laws and regulations should be enforced, mangrove scientific research should be strengthened; and mangrove conservation awareness of local community should be raised on conservation of mangroves.

Keywords: Guangdong; Mangrove; Present status of resource; Conservation.

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Introduction

Mangrove is well known of 'sea forest', 'green island', 'coastal soldier' as well as one of the highest productive ecosystems of the world. It provides great contribution to the near-shear fishery, biodiversity conservation, ecotourism, fighting for natural disasters and pollution (Farnsworth *et al.* 1997; Field 1999; Hamilton *et al.* 1984; Kathiresan *et al.* 2003; Lin *et al.* 2000; Macnae 1968; Robertsen *et al.* 1992; Zhou *et al.* 1998). This paper presented the current status of mangrove resource in Guangdong Province and whole mangrove resources of China, according to author's field investigation in past 5 years and the report of the national mangrove survey was achieved in September 2001 (Guangdong Forestry Bureau 2002). The mangrove resources that were distributed in five provinces of China (Zhejiang, Fujian, Guangdong, Guangxi and Hainan) were compared with the whole mangrove resources of China.

Mangrove area in Guangdong Province

There was mature mangrove land of 21937.6 hm² in China according the national mangrove survey in 2001, of which, Guangxi is 8287.6 hm² (37.8%), Guangdong 9084.0 hm² (41.4%), Hainan 3930.3 hm² (17.9%), Fujian 615.1 hm², (2.8%), and Zhejiang is 20.6 hm² (0.1%). The comparison of different kinds mangrove land area between Guangdong Province and the whole China is given in Table 1.

Tabel 1. Mangrove land areas in Guangdong and in the whole China (hm²)

Mangrove land type	China	Guangdong Province
Mature mangrove land	21937.6	9084.0
Young mangrove land	1137.8	373.9
Nature mangrove re-planting land	687.2	607.4
Total mangrove land area	75687.6	10065.3

The associations and species of mangrove in Guangdong Province

According to both former researches and author's field observation, the mangrove flora in Guangdong Province consists of 50 species (including 3 varieties), belonging to 28 families. Among them, there were 13 mangrove species, belonging to 8 families, i.e. *Acrostichum aureum*, *Acrostichum speciosum*, *Bruguiera gymnorrhiza*, *Ceriops tagal*, *Kandelia candel*, *Rhizophora stylosa*, *Acanthus ebrectearus*, *Acanthus ilicifolius*, *Lumintzera littorea*, *Excoecaria agallocha*, *Heritiera littoralis*, *Aegiceras corniculatum*, *Avicennia marina*; 9 semi-mangrove species (including 1 variety), belonging to 6 families, i.e. *Clerodendron inerme*, *Premna obtusifolia*, *Vitex trifolia* var. *simplicifolia*, *Pongamia pinnata*, *Cerbera manghas*, *Pluchea indica*, *Hibiscus tiliaceus*, *Thespesia populnea*, *Scaevola hainanensis*; 15 associate species (including 1 varieties), belonging to 11 families, i.e. *Derris trifoliata*, *Canavalia maritima*, *Chorisis repens*, *Abutilon indicum*, *Scaevola sericea*, *Cassytha filiformis*, *Gymnanthera oblonga*, *Tylophora arenicola*, *Myoporum bontoides*, *Sesuvium portulacastrum*, *Trianthema portulacastrum*, *Kochia scoparia* var. *sieversiana*,

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Sporobolus virginicus, *Spinifex littoreus*, *Lygodium japonicum*. And other 13 species (including 1 variety), belonging to 9 families, are regarded as land or salt wetland plant species and commonly distribute along the edges of mangrove communities (*Erythrina variegata*, *Bridelia tomentosa*, *Wikstroemia indica*, *Phoenix hanceana*, *Pandanus tectorius*, *Rhodomyrtus tomentosa*, *Ipomoea pes-caprae*, *Phragmites australis*, *Zoysia matrella*, *Wedelia chinensis*, *Suaeda australis*, *Eleocharis acutangula*, *Cyperus malaccensis* var. *brevifolius* and etc.). There were 3 families, 7 exotic species introduced from Hainan Province of PRC (*Bruguiera sexangula*, *Rhizophora apiculata*, *Xylocarpus granatum*, *Sonneratia alba*, *S. apetala*, *S. caseolaris*, *S. hainanensis*). The author recorded *Vitex trifolia* var. *simplicifolia* and *Scaevola hainanensis* as 2 new semi-mangrove species of the area.

Casuarina equisetifolia was mistakenly listed as semi-mangrove tree species by some authors (Chen *et al.* 2001), since it can only grow on the higher land of upper tide line other than the environments suitable for real semi-mangrove tree species. It is an excellent and dominant species of the coastal dry land sheltering forests, so its ecosystem management is completely different with mangrove ecosystems.

There are about 14 major mangrove associations, each with one or a few species as the dominant species with tree height of 2-5 m and with coverage rate of 0.5-0.95. They distribute at more than 100 locations along the coastlines of Guangdong Province. Among the mangrove associations, Ass. *Avicennia marina* occupies the largest area. The progress succession of each mangrove association tends to become a single species dominant association as its succession climax.

The area data of the major mangrove associations are listed as follows: Ass. *Avicennia marina* 1 606.9 hm²; Ass.

Aegiceras corniculatum 1 082.9 hm²; Ass. *Kandelia candel* 163.3 hm²; Ass. *Sonneratia apetala* or *S. caseolaris*, 113.9 hm²; Ass. *Rhizophora stylosa* 67.3 hm²; Ass. *Avicennia marina* + *Rhizophora stylosa*, 842.0 hm²; Ass. *Kandelia candel*. *Aegiceras corniculatum*, 684.2 hm²; Ass. *Avicennia marina* + *Aegiceras corniculatum*, 610.4 hm²; Ass. *Rhizophora stylosa* - *Aegiceras corniculatum*, 580.9 hm²; Ass. *Rhizophora stylosa* + *Kandelia candel*- *Aegiceras corniculatum*+*Avicennia marina*, 503.7 hm²; Ass. *Rhizophora stylosa* + *Kandelia candel*, 397.7 hm²; Ass. *Rhizophora stylosa*+ *Avicennia marina*, 288.9 hm²; Ass. *Kandelia candel* + *Aegiceras corniculatum* + *Avicennia marina*, 194.1 hm²; Ass. *Aegiceras corniculatum*+ *Kandelia candel*, 181.2 hm²; Ass. *Aegiceras corniculatum*+ *Kandelia candel*+ *Acanthus ilicifolius*, 125.6 hm²; Ass. *Avicennia marina*+ *Kandelia candel* + *Aegiceras corniculatum*, 105.7 hm²; Ass. *Aegiceras corniculatum* + *Rhizophora stylosa* + *Kandelia candel*, 111.9 hm²; Ass. *Excoecaria agallocha*+other species, 115.1 hm²; Ass. *Acanthus ilicifolius* + *Kandelia candel* + *Aegiceras corniculatum*, 116.4 hm², etc.

Mangrove coverage rate and tree height in Guangdong Province and in the whole China

Three coverage rates are categorized into three groups as dense, middle and sparse, with the coverage rates ranging 0.20-0.39, 0.40-0.69 and 0.70-1.00 respectively (Table 2). The mangrove lands mostly with the coverage rates above 0.7 occupied a mangrove area of 6181.6 hm², accounting for 68.0% of the total mangrove area in Guangdong. And the mangrove lands with tree height mostly less than 2 m occupied an area of 7 073.3 hm², accounting for 77.8% of the total mangrove area in Guangdong. The six grades of tree height were shown in Table 3.

Table 2. Mangrove land area with different forest coverage in Guangdong Province and in the whole China (hm²)

Region	Ownership	Coverage Rate			
		Total	Sparse (0.20-0.39)	Middle (0.40-0.69)	Dense (0.70-1.00)
China	Subtotal	21937.6	1772.2	5218.7	14946.7
	Stated owned	18146.0	1519.4	4161.7	12464.9
	Collective Owned	3791.6	252.8	1057.0	2481.8
	Subtotal	9084.0	924.1	1978.3	6181.6
Guangdong	Stated owned	8475.0	858.7	1827.6	5788.7
	Collective Owned	609.0	65.4	150.7	392.9

Notes: The area of the dominant mangrove associations (Ass. *Avicennia marina*) is 1 606.9 hm².

Table 3. Mangrove land area with different tree height in Guangdong Province and in the whole China (hm²)

Region	Total	Tree high grade					
		≤1.9 m	2.0-3.9 m	4.0-5.9 m	6.0-7.9 m	8.0-9.9 m	≥10.0 m
China	21937.6	15074.8	5538.1	888.2	391.0	9.5	36.0
Guangdong	9084.0	7073.3	1712.3	252.7	37.8	6.9	1.0

Mangrove converted and occupied for other usage

Since 1980, 12 923.7 hm² of mangrove land of China has been converted or occupied for economical exploitation, of

which, 7 912.2 hm² was in Guangdong Province (Table 4). The area comparison of mangrove in China as well as in Guangdong Province was shown in Table 5. Since 1950, a 54.6% mangrove forests has disappeared due to paddy

rice reclaim, aquaculture (mainly shrimp pond) and city constructions of the mangrove lands. In 1990, the mangrove resources of China dropped into the lowest line.

Therefore the nation began to reforest mangrove and there is an increase of 50.6 % in the current mangrove area.

Table 4. Mangrove converted for other usage since 1980

(hm²)

Region	Ownership	Total	Cause			
			Reclaimed for rice field	Dig for aquaculture	Engineering construction	Others
China	Subtotal	12923.7	67.9	12604.5	234.7	16.6
	State owned	12857.1	67.9	12568.1	211.9	9.2
	Collective owned	66.6		36.4	22.8	7.4
Guangdong	Subtotal	7912.2		7767.5	139.4	5.3
	State owned	7912.2		7767.5	139.4	5.3
	Collective owned	0				

Table 5. Area changes of mangrove in Guangdong Province and in the whole China

(hm²)

Region	Year			Decrease		Increase	
	1950	1990	2001	Since 1950	Percentage	Since 1990	Percentage
Guangdong	21288	3813	9084.0	-12204.0	-57.3	+5271.0	+138.2
China	48216	14571	21937.6	-26349.0	-54.6	+7366.6	+50.6

Current mangrove conservation management in China

Relevant laws and regulations for mangrove conservation

At present, China protect forest resource mainly through the following laws and regulations: "Environmental Protection Law of PRC", "Ocean Environmental Protection Law of PRC", "Protection Regulations Against Destruction of Ocean Environments by Coastal Engineering of PRC", "Forest Law of PRC", "Wild Life Protection Law of PRC". The municipal government of Zhanjiang Prefecture announced "Mangrove Resource Management Regulations of Zhanjiang" in March 2001 as the third regional specialized mangrove conservation law after Hainan and Guangxi. Applying the laws and regulations on mangrove issues still needs to be enforced as the governmental branches and agencies are pretty weak in carrying out the regulation or even the regular management of the local mangrove resources.

Mangrove nature reserve construction and management

In early 1980's, China began to build mangrove reserve, and up to now 13 mangrove reserves have been established in China, of which, 6 reserves are at national level, 1 at provincial level, and 6 at prefecture or county level. These mangrove reserves cover a mangrove land area of 44 117.1 hm², and enable 6 717.5 hm² of mangrove forests or 30.6% of the total mangrove areas of the nation to be under in-site conservation. These mangrove reserves are managed by forestry departments (10 reserves), ocean and fishery departments (2 reserves), and environmental protection agency (1 reserve). There are 4 mangrove reserves

in Guangdong Province: Shengzhen National Mangrove Reserve (granted by The State Government in 1988, covering an area of 864 hm² and 82 hm² of mangrove protected); Zhanjiang National Mangrove Nature Reserve (granted by The State Government in 1997, covering an area of 20 278.8 hm² and 7306 hm² of mangrove protected and it was appointed as one site of wetland of importance in Jan. 2002); Tianbai Mangrove Nature Reserve (Granted at Prefecture level in 1999, covering a land area of 1 905 hm² and 150.9 hm² of mangrove protected); Aoqi Mangrove Reserve (Granted at Prefecture level in 1999, covering a land area of 1 000 hm² and 74.6 hm² of mangrove protected).

Strategy for mangrove conservation in Guangdong Province

Research on conservation of mangroves was highly evaluated internationally, and more and more cooperation has been witnessed in Asia-Pacific region (ISME, UNESCO & MAB 2000). Concerning current mangrove resource status in Guangdong Province, the mangrove conservation efforts are still weakly empowered and should be strengthened intensively in China, especially in Guangdong Province. The following strategy suggestions are proposed for its conservation management approaches:

(1) *Enforcing mangrove laws and regulations.* It is urgent to stop the economic exploitation of mangrove land, especially to stop conveying the land into shrimp farms, and to take stronger action to protect migratory shore birds, molluscus, crabs, fish and other biodiversities and their coastal habitat, including the mangroves and the associated mud-flats.

(2) *Better cooperation between departments and experts.* Considering the mangrove as the coastal endangered nature ecosystems of the world, in particular that the man-

grove areas in Leizhou Peninsula was appointed as one of sites of Ramsar wetland of importance, the mangrove reserve's authorities should adapt themselves to the international standards on wetland conservation management which needs special expertise.

(3) *Better mangrove planting planning on mudflats.* It is estimated that there are 22 260.6 hm² of mudflat areas suitable for mangrove growing. In considering of afforesting these mudflats, the exotic species invasion should be evaluated before further planting, and to encourage planting with native species. The suitable inter tideland for planting mangrove and the planting methodology should be evaluated in security of the successful mangrove afforestation efforts.

(4) *Enforcing mangrove restoration to achieve marine biodiversity conservation.* Mangrove planting project for coastal protection could be considered as one of the very economic approaches, which also could be combined with other suitable technologies to bring new coastal environmental engineering practice.

(5) *Accelerating mangrove nature reserve construction.* Especially, the personnel arrangement should be secured to patrol as well as to guard a sustainable way of mangrove resource utilization.

(6) *Strengthening mangrove scientific research.* With the expanding of newly planted mangrove areas, it is time to figure out how the mangrove land could generate revenue for local economy. The sustainable way of using the mangrove wetland calls for scientific demonstration trials as well.

(7) *Confirming the mangrove land ownership.* We should carry out land ownership certification issuing and mark mangrove area boundary, so as to safeguard the mangrove resources from further destruction with uncertain land ownership.

(8) *Strengthening the education of environmental and mangrove conservation for the public and the local mangrove region people.* Through involving local community members in awareness raising workshops and improving

their resource management skills, these local communities could play a major role in the resource management decision process. This will empower the conservation of our precious mangrove resources in sustainable developments.

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